

U.S. DEPARTMENT OF COMMERCE, PATENT AND TRADEMARK OFFICE		DATE: <b>August 17, 2001</b>
<b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>		U.S. APPLN. NO. (if known): <b>09/926033</b>
INTERNATIONAL APPLICATION NO.: <b>PCT/JP00/01221</b>	INTERNATIONAL FILING DATE: <b>MARCH 2, 2000</b>	PRIORITY DATE CLAIMED: <b>MARCH 3, 1999</b>
TITLE OF INVENTION: <b>PHOTOSENSITIVE RESIN COMPOSITION, PHOTOSENSITIVE ELEMENT USING THE SAME, PROCESS FOR PRODUCING RESIST PATTERN AND PROCESS FOR PRODUCING PRINTED WIRING BOARD</b>		
APPLICANT(S) FOR DO/EO/US: <b>Takeshi OOHASHI and Chikara ISHIKAWA</b>		
Applicant hereby submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
<ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the time limit set in 35 USC 371(b) and PCT Articles 22 and 39(1).</li> <li>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)): <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)</li> </ol> </li> <li>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> have been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</li> <li>10. <input checked="" type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol>		
<b>ITEMS 11. TO 16. BELOW CONCERN OTHER DOCUMENT(S) OR INFORMATION INCLUDED:</b>		
<ol style="list-style-type: none"> <li>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</li> <li>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. ASSIGNEE NAME AND ADDRESS: <b>HITACHI CHEMICAL COMPANY, LTD., Tokyo, Japan</b> <b>Please publish the assignee data with the application.</b></li> <li>13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment. <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment</li> <li>14. <input type="checkbox"/> A substitute specification.</li> <li>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</li> <li>16. <input checked="" type="checkbox"/> Other items or information: International search report.</li> </ol>		

U.S. APPLICATION NO. (if known) <b>09/926033</b>	INTERNATIONAL APPLICATION NO. <b>PCT/JP00/01221</b>	DATE: <b>August 17, 2001</b>
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17. <input checked="" type="checkbox"/> The following fees are submitted:  <b>Basic National Fee (37 CFR 1.492(a)(1)-(5):</b> Search Report has been prepared by the EPO or JPO: ..... \$860.00  International preliminary examination fee paid to USPTO (37 CFR 1.482) ..... \$690.00  No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... \$710.00  Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$1000.00  International preliminary examination fee (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) ..... \$100.00  <div style="text-align: right;"><b>ENTER APPROPRIATE BASIC FEE AMOUNT = \$ 860.00</b></div>	CALCULATIONS	PTO USE ONLY
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Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than <u>  20  </u> x <u>  30  </u> months from the earliest claimed priority date (37 CFR 1.492(e)).	<b>\$ 130.00</b>	
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CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
TOTAL	36 -20 =	16	X \$ 18.00	<b>\$ 288.00</b>	
INDEPENDENT	3 - 3 =		X \$ 80.00		
Multiple dependent claims(s) (if applicable)			+ \$270.00	<b>\$ 270.00</b>	
<b>TOTAL OF ABOVE CALCULATIONS =</b>				<b>\$1,548.00</b>	
Reduction by 1/2 for filing by small entity, if applicable. (Note 37 CFR 1.9, 1.27, 1.28).					
<b>SUBTOTAL =</b>				<b>\$1,548.00</b>	
Processing fee of <b>\$130.00</b> for furnishing the English translation later than <u>  20  </u> <u>  30  </u> months from the earliest claimed priority date (37 CFR 1.492(f)).				+	
<b>TOTAL NATIONAL FEE =</b>				<b>\$1,548.00</b>	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). <b>\$40.00 per property +</b>					
<b>TOTAL FEES ENCLOSED =</b>				<b>\$1,548.00</b>	
				Amount to be:	
				refunded	\$ _____
				charged	\$ _____
					\$ _____

U.S. APPLICATION NO. (if known)	INTERNATIONAL APPLICATION NO.  <b>PCT/JP00/01221</b>	DATE: <b>August 17, 2001</b>
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- a. ☒ A check in the amount of \$1,548.00 to cover the above fees is enclosed. (\$860.00 for basic filing fee; \$288.00 for 16 additional claims; \$270.00 for multiple dependent claims and \$130.00 for late filing of the declaration). (This paper is filed in triplicate)
- b. ☐ Please charge my Deposit Account No. 01-2340 in the amount of \$     to cover the above fees. (A duplicate copy of this sheet is enclosed.)
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 01-2340.

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed to request that the application be restored to pending status.

**Send All Correspondence To:**



23850

PATENT TRADEMARK OFFICE

  
SIGNATURE

Donald W. Hanson  
NAME

27,133  
REGISTRATION NUMBER

WH/yap

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09/926033

JCO3 Rec'd PCT/PTO 17 AUG 2001

**PATENT  
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re application of: **Takeshi OOHASHI et al.**

Serial No.: **Not Yet Assigned**  
**(PCT/JP00/01221)**

Filed: **August 17, 2001**

For: **PHOTOSENSITIVE RESIN COMPOSITION, PHOTOSENSITIVE ELEMENT  
USING THE SAME, PROCESS FOR PRODUCING RESIST PATTERN AND  
PROCESS FOR PRODUCING PRINTED WIRING BOARD**

**PRELIMINARY AMENDMENT**

Commissioner for Patents  
Washington, D.C. 20231

August 17, 2001

Sir:

Prior to the calculation of the filing fees of the above application, please amend the application as follows:

**IN THE CLAIMS:**

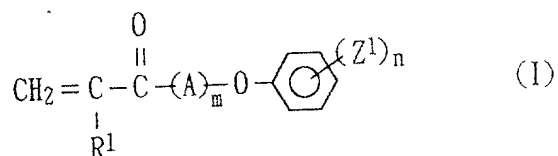
Please amend the claims as follows:

1. (Amended) A photosensitive resin composition comprising

(A) a carboxyl group-containing binder polymer which contains styrene or a styrene derivative as a copolymerized constituent,

(B) a photo-polymerization initiator, and

(C) a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond which comprises a compound represented by the general formula (I)



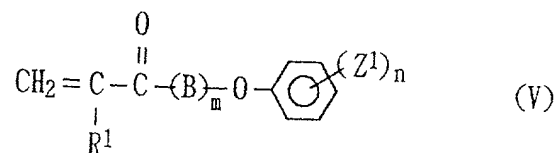
wherein R<sup>1</sup> is a hydrogen atom or a methyl group, A is an alkyleneoxy group of 2 to 6 carbon atoms, Z<sup>1</sup> is a halogen atom, an alkyl group of 1 to 20 carbon atoms, a cycloalkyl group of 3 to 10 carbon atoms, an aryl group of 6 to 14 carbon atoms, an amino group, an alkylamino group of 1 to 10 carbon atoms, a dialkylamino group of 2 to 20 carbon atoms, a nitro group, a cyano group, a mercapto group, an alkylmercapto group of 1 to 10 carbon atoms, an allyl group, a hydroxyalkyl group of 1 to 20 carbon atoms, a carboxyalkyl group wherein the alkyl group has 1 to 10 carbon atoms, an acyl group having an alkyl group of 1 to 10 carbon atoms, an alkoxy group of 1 to 20 carbon atoms or a group containing an heterocyclic group, m is an integer of 6 to 20, and n is an integer of 0 to 5.

7. (Amended) A photosensitive resin composition comprising

(A') a binder polymer,

(B) a photo-polymerization initiator, and

(C') a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond which comprises a compound represented by the general formula (V)



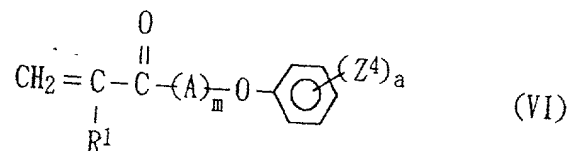
wherein R<sup>1</sup> is a hydrogen atom or a methyl group, B is an ethylenoxy group, Z<sup>1</sup> is a halogen atom, an alkyl group of 1 to 20 carbon atoms, a cycloalkyl group of 3 to 10 carbon atoms, an aryl group of 6 to 14 carbon atoms, an amino group, an alkylamino group of 1 to 10 carbon atoms, a dialkylamino group of 2 to 20 carbon atoms, a nitro group, a cyano group, a mercapto group, an alkylmercapto group of 1 to 10 carbon atoms, an allyl group, a hydroxyalkyl group of 1 to 20 carbon atoms, a carboxyalkyl group wherein the alkyl group has 1 to 10 carbon atoms, an acyl group having an alkyl group of 1 to 10 carbon atoms, an alkoxy group of 1 to 20 carbon atoms or a group containing an heterocyclic group, at least one Z<sup>1</sup> is an alkyl group of 1 to 20 carbon atoms, m is an integer of 6 to 18, and n is an integer of 1 to 5.

8. (Amended) A photosensitive resin composition comprising

(A') a binder polymer,

(B) a photo-polymerization initiator, and

(C'') a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond which comprises a compound represented by the general formula (VI)

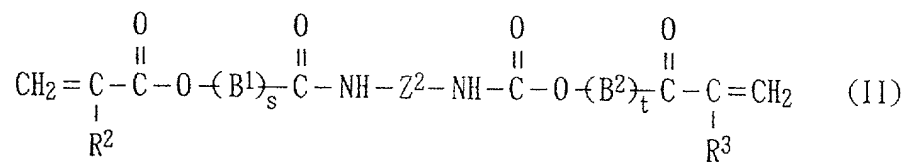


wherein R<sup>1</sup> is a hydrogen atom or a methyl group, A is an alkyleneoxy group of 2 to 6 carbon atoms, Z<sup>4</sup> is an alkyl group of 1 to 20 carbon atoms, m is an integer of 6 to 18, and a is an integer of 1 to 5.

Please add the following new claims:

14. (New) The photosensitive resin composition of claim 7, wherein the photo-polymerization initiator as the component (B) is a 2,4,5-triarylimidazole dimer.

15. (New) The photosensitive resin composition of claim 7, wherein the component (C') is a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond, which comprises a compound represented by the general formula (V) and a compound represented by the general formula (II)



wherein  $R^2$  and  $R^3$  each independently are a hydrogen atom or an alkyl group of 1 to 6 carbon atoms,  $B^1$  and  $B^2$  each independently are an alkyleneoxy group of 2 to 6 carbon atoms,  $Z^2$  is a divalent hydrocarbon group of 1 to 16 carbon atoms, and  $s$  and  $t$  each independently are an integer of 1 to 28.

16. (New) The photosensitive resin composition of claim 7, wherein the component (A') is a carboxyl group-containing binder polymer which contains a styrene or styrene derivative as a copolymerized constituent and comprises copolymerized constituents consisting of 15 to 35% by weight of methacrylic acid, 10 to 35% by weight of styrene or a styrene derivative and 30 to 75% by weight of a monomer represented by the general formula (III)



wherein  $R^5$  is a hydrogen atom or a methyl group, and  $R^6$  is an alkyl group of 1 to 12 carbon atoms.

17. (New) The photosensitive resin composition of claim 7, wherein the component (A') is a carboxyl group-containing binder polymer which contains styrene or a styrene derivative as a copolymerized constituent and has a weight average molecular weight of 30,000 to 80,000.

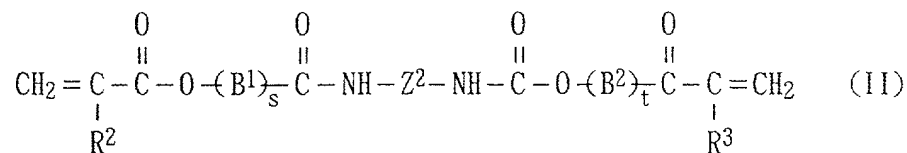
18. (New) The photosensitive resin composition of claim 7, which comprises 40 to 70 parts by weight of the component (A'), 0.1 to 10 parts by weight of the component (B) and 30 to 60 parts



by weight of the component (C') relative to 100 parts by weight of a sum total of the component (A') and the component (C').

19. (New) The photosensitive resin composition of claim 8, wherein the photo-polymerization initiator as the component (B) is a 2,4,5-triarylimidazole dimer.

20. (New) The photosensitive resin composition of claim 8, wherein the component (C'') is a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond, which comprises a compound represented by the general formula (VI) and a compound represented by the general formula (II)



wherein  $\text{R}^2$  and  $\text{R}^3$  each independently are a hydrogen atom or an alkyl group of 1 to 6 carbon atoms,  $\text{B}^1$  and  $\text{B}^2$  each independently are an alkyleneoxy group of 2 to 6 carbon 15 atoms,  $\text{Z}^2$  is a divalent hydrocarbon group of 1 to 16 carbon atoms, and  $s$  and  $t$  each independently are an integer of 1 to 28.

21. (New) The photosensitive resin composition of claim 8, wherein the component (A') is a carboxyl group-containing binder polymer which contains a styrene or styrene derivative as a copolymerized constituent and comprises copolymerized constituents consisting of 15 to 35% by

weight of methacrylic acid, 10 to 35% by weight of styrene or a styrene derivative and 30 to 75% by weight of a monomer represented by the general formula (III)



wherein R<sup>5</sup> is a hydrogen atom or a methyl group, and R<sup>6</sup> is an alkyl group of 1 to 12 carbon atoms.

22. (New) The photosensitive resin composition of claim 8, wherein the component (A') is a carboxyl group-containing binder polymer which contains styrene or a styrene derivative as a copolymerized constituent and has a weight average molecular weight of 30,000 to 80,000.

23. (New) The photosensitive resin composition of claim 8, which comprises 40 to 70 parts by weight of the component (A'), 0.1 to 10 parts by weight of the component (B) and 30 to 60 parts by weight of the component (C' ') relative to 100 parts by weight of a sum total of the component (A') and the component (C' ').

24. (New) The photosensitive resin composition of claim 1, which further contains 2,2-bis[4-(acryloxypolyethoxy)phenyl]propane or 2,2-bis[4-(methacryloxypolyethoxy)phenyl]propane as a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond.

25. (New) The photosensitive resin composition of claim 7, which further contains 2,2-bis[4-(acryloxypolyethoxy)phenyl]propane or 2,2-bis[4-(methacryloxypolyethoxy)phenyl]propane as a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond.

26. (New) The photosensitive resin composition of claim 8, which further contains 2,2-bis[4-(acryloxypolyethoxy)phenyl]propane or 2,2-bis[4-(methacryloxypolyethoxy)phenyl]propane as a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond.

REMARKS

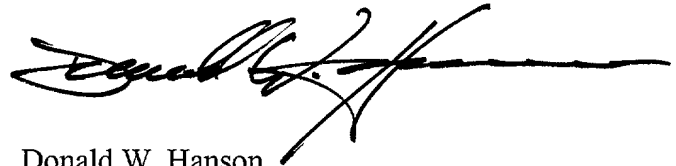
The above proposed amendment is submitted to place the claims in substantially the same conditions as the claims which have been amended under Article 34 in the international application. Early and favorable action is awaited.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

In the event there are any additional fees required, please charge our Deposit Account No. 01-2340.

Respectfully submitted,

ARMSTRONG, WESTERMAN, HATTORI,  
McLELAND & NAUGHTON, LLP



Donald W. Hanson  
Reg. No. 27,133

Atty. Docket No. 011022  
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Tel: (202) 659-2930  
DWH/yap

VERSION WITH MARKINGS TO SHOW CHANGES MADE

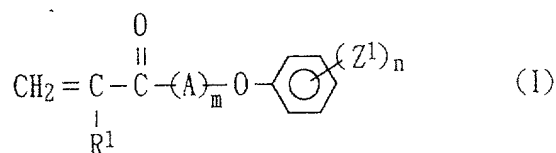
Claims 1, 7 and 8 have been amended as follows:

1. (Amended) A photosensitive resin composition comprising

(A) a carboxyl group-containing binder polymer which contains styrene or a styrene derivative as a copolymerized constituent,

(B) a photo-polymerization initiator, and

(C) a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond which comprises a compound represented by the general formula (I)



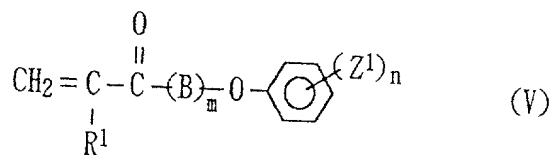
wherein R<sup>1</sup> is a hydrogen atom or a methyl group, A is an alkyleneoxy group of 2 to 6 carbon atoms, Z<sup>1</sup> is a halogen atom, an alkyl group of 1 to 20 carbon atoms, a cycloalkyl group of 3 to 10 carbon atoms, an aryl group of 6 to 14 carbon atoms, an amino group, an alkylamino group of 1 to 10 carbon atoms, a dialkylamino group of 2 to 20 carbon atoms, a nitro group, a cyano group, a mercapto group, an alkylmercapto group of 1 to 10 carbon atoms, an allyl group, a hydroxyalkyl group of 1 to 20 carbon atoms, a carboxyalkyl group wherein the alkyl group has 1 to 10 carbon atoms, an acyl group having an alkyl group of 1 to 10 carbon atoms, an alkoxy group of 1 to 20 carbon atoms or a group containing an heterocyclic group, m is an integer of 4 to 20, and n is an integer of 0 to 5.

7. (Amended) A photosensitive resin composition comprising

(A) a binder polymer,

(B) a photo-polymerization initiator, and

(C) a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond which comprises a compound represented by the general formula (V)



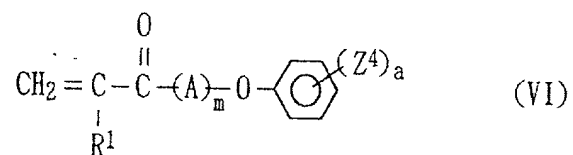
wherein  $\text{R}^1$  is a hydrogen atom or a methyl group, B is an ethylenoxy group,  $\text{Z}^1$  is a halogen atom, an alkyl group of 1 to 20 carbon atoms, a cycloalkyl group of 3 to 10 carbon atoms, an aryl group of 6 to 14 carbon atoms, an amino group, an alkylamino group of 1 to 10 carbon atoms, a dialkylamino group of 2 to 20 carbon atoms, a nitro group, a cyano group, a mercapto group, an alkylmercapto group of 1 to 10 carbon atoms, an allyl group, a hydroxyalkyl group of 1 to 20 carbon atoms, a carboxyalkyl group wherein the alkyl group has 1 to 10 carbon atoms, an acyl group having an alkyl group of 1 to 10 carbon atoms, an alkoxy group of 1 to 20 carbon atoms or a group containing an heterocyclic group, at least one  $\text{Z}^1$  is an alkyl group of 1 to 20 carbon atoms, m is an integer of ~~4~~ 6 to ~~20~~ 18, and n is an integer of ~~0~~ 1 to 5.

8. (Amended) A photosensitive resin composition comprising

(A) a binder polymer,

(B) a photo-polymerization initiator, and

(C' ') a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond which comprises a compound represented by the general formula (VI)



wherein R<sup>1</sup> is a hydrogen atom or a methyl group, A is an alkyleneoxy group of 2 to 6 carbon atoms, Z<sup>4</sup> is an alkyl group of 1 to 20 carbon atoms, m is an integer of 4 6 to 20 18, and a is an integer of 1 to 5.

## SPECIFICATION

PHOTOSENSITIVE RESIN COMPOSITION, PHOTOSENSITIVE ELEMENT  
USING THE SAME, PROCESS FOR PRODUCING RESIST PATTERN AND  
5 PROCESS FOR PRODUCING PRINTED WIRING BOARD

## Technical Field

The invention relates to a photosensitive resin  
composition, a photosensitive element using the same, a  
10 process for producing a resist pattern and a process for  
producing a printed wiring board.

## Background Art

In the manufacturing industry of printed wiring boards,  
15 photosensitive elements produced by using a photosensitive  
resin composition, a support and a protective film have been  
widely used as the resist materials in etching, plating or  
the like.

Printed wiring boards are produced by laminating a  
20 photosensitive element on a copper substrate, exposing it  
with patterned light, removing unexposed areas with a  
developer, carrying out etching or plating to form circuit  
patterns, and then peeling off the cured areas from the  
substrate.

25 Developers mainly used to remove the unexposed areas are  
of alkali development type, such as a sodium carbonate  
solution. Developers are used repeatedly so long as they  
substantially retain the ability of dissolving photosensitive  
resin composition layers, and photosensitive resin  
30 compositions are dissolved or dispersed in the developers  
during development.

With the recent increase in the density of printed  
wiring boards, the contact area between copper substrates and  
patterned photosensitive resin composition layers has been  
35 reduced, requiring photosensitive elements which exhibit



excellent adhesiveness, resolution, tenting reliability and chemical resistance in etching or plating step.

Also there is the problem of the aggregation of the photosensitive resin composition dissolved or dispersed in  
5 developers. When the developer is sprayed again with a pump or the like, the aggregates dispersed in the developers adhere onto developed printed wiring boards, causing undesirable defects during the following etching or plating step. To prevent such defects, photosensitive resin  
10 compositions require good dispersion stability in developers.

As to resists improved in chemical resistance, for example, resists containing copolymers of styrene monomers are disclosed in Japanese Patent Application Examined Publication Nos. 55-38961 (1980) and 54-25957 (1979),  
15 Japanese Patent Application Unexamined Publication Nos. 2-289607 (1990), 4-347859 (1992) and 4-285960 (1992). However, the minimum development time of the resists is so long as to reduce resolution.

To improve chemical resistance, the use of photo-  
20 polymerizable compounds having isocyanurate rings is proposed in Japanese Patent Application Unexamined Publication Nos. 60-77844 (1985), 62-290705 (1987), 60-14212 (1985), 59-222480 (1984), 1-14190 (1989), 57-55914 (1982), 5-216224 (1993) and 5-273754 (1993), which however involves the problem that the  
25 cured film is hard and brittle.

As to photosensitive resin compositions with good tenting reliability, a photosensitive resin composition using vinylurethane compounds is disclosed in Japanese Patent Application Unexamined Publication No. 7-128851 (1995).  
30 However, with the recent increase in the density and accuracy of printed wiring boards, the requirement for high resolution has become yearly strict, and the addition of vinylurethane compounds alone cannot improve the resolution of the photosensitive resin composition. This is assumed to be

caused by the poor developability of the isocyanate residues having urethane bonds.

In Japanese Patent Application Unexamined Publication No. 8-179503 (1996) is disclosed that photosensitive resin compositions having a low biologically chemical oxygen demand and a low chemical oxygen demand and being less apt to aggregate in developers are obtainable by using, as an ethylenically unsaturated compound, a specific urethane compound having in its molecule blocked ethylenoxy or propylenoxy groups. The photosensitive resin compositions however involve the defects of low adhesiveness on overdevelopment and insufficient reduction in minimum development time.

In Japanese Patent Application Unexamined Publication No. 5-232699 (1993) disclosed are photosensitive resin compositions containing acrylate compounds, which, having extremely hydrophilic polyalkylene glycol chains, are excellent in developability and resolution. The photosensitive resin compositions involve problems in that those with only polyethylene glycol chains suffer from defective resist shapes, jagged etched-lines or the like, while those with only polypropylene glycol chains tend to separate to scum in alkaline developers, and if the scum adheres to substrates, it causes short circuit or disconnection.

#### Disclosure of Invention

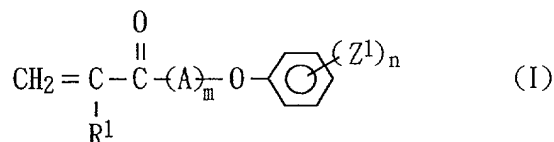
An object of the invention is to provide a photosensitive resin composition which is excellent in adhesiveness and low tendency to scum.

Accordingly, the invention provides a photosensitive resin composition comprising

(A) a carboxyl group-containing binder polymer which contains styrene or a styrene derivative as a copolymerized constituent,

(B) a photo-polymerization initiator, and

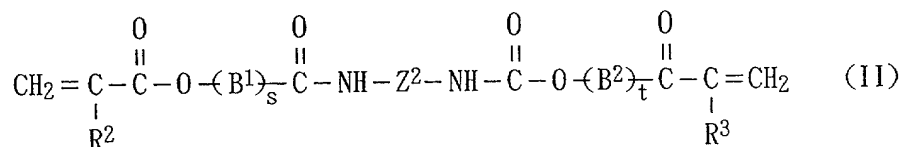
(C) a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond which comprises a compound represented by the general formula (I)



wherein  $\text{R}^1$  is a hydrogen atom or a methyl group, A is an alkyleneoxy group of 2 to 6 carbon atoms,  $\text{Z}^1$  is a halogen atom, an alkyl group of 1 to 20 carbon atoms, a cycloalkyl group of 3 to 10 carbon atoms, an aryl group of 6 to 14 carbon atoms, an amino group, an alkylamino group of 1 to 10 carbon atoms, a dialkylamino group of 2 to 20 carbon atoms, a nitro group, a cyano group, a mercapto group, an alkylmercapto group of 1 to 10 carbon atoms, an allyl group, a hydroxyalkyl group of 1 to 20 carbon atoms, a carboxyalkyl group wherein the alkyl group has 1 to 10 carbon atoms, an acyl group having an alkyl group of 1 to 10 carbon atoms, an alkoxy group of 1 to 20 carbon atoms or a group containing an heterocyclic group, m is an integer of 4 to 20, and n is an integer of 0 to 5.

In the photosensitive resin composition of the invention, preferably, the photo-polymerization initiator as the component (B) is a 2,4,5-triarylimidazole dimer. The photosensitive resin composition of this embodiment has more excellent adhesiveness and has high sensitivity.

In the photosensitive resin composition of the invention, preferably, the component (C) is a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond, which comprises a compound represented by the general formula (I) and a compound represented by the general formula (II)



5

wherein  $\text{R}^2$  and  $\text{R}^3$  each independently are a hydrogen atom or an alkyl group of 1 to 6 carbon atoms,  $\text{B}^1$  and  $\text{B}^2$  each independently are as defined above for A in the general formula (I),  $\text{Z}^2$  is a divalent hydrocarbon group of 1 to 16 carbon atoms, and s and t each independently are an integer of 1 to 28. The photosensitive resin composition of this embodiment is particularly excellent in adhesiveness.

In the photosensitive resin composition of the invention, preferably, the component (A) is a carboxyl group-containing binder polymer which contains styrene or a styrene derivative as a copolymerized constituent and comprises copolymerized constituents consisting of 15 to 35 % by weight of methacrylic acid, 10 to 35 % by weight of styrene or a styrene derivative and 30 to 75 % by weight of a monomer represented by the general formula (III)



wherein  $\text{R}^5$  is a hydrogen atom or a methyl group, and  $\text{R}^6$  is an alkyl group of 1 to 12 carbon atoms. The photosensitive resin composition of this embodiment is particularly excellent in adhesiveness.

In the photosensitive resin composition of the invention, preferably, the component (A) is a carboxyl group-containing binder polymer which contains styrene or a styrene derivative as a copolymerized constituent and has a weight average molecular weight of 30,000 to 80,000. The photosensitive resin composition of this embodiment is particularly excellent in film quality and resolution.

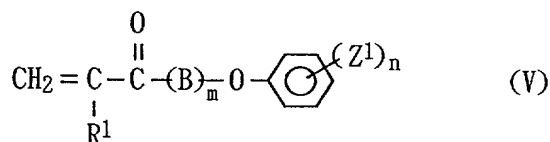
The photosensitive resin composition of the invention, preferably, comprises 40 to 70 parts by weight of the component (A), 0.1 to 10 parts by weight of the component (B) and 30 to 60 parts by weight of the component (C) relative to 100 parts by weight of a sum total of the component (A) and the component (C). The photosensitive resin composition of this embodiment is particularly excellent in adhesiveness and low tendency to scum.

The invention further provides a photosensitive resin composition comprising

(A') a binder polymer,

(B) a photo-polymerization initiator, and

(C') a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond which comprises a compound represented by the general formula (V)



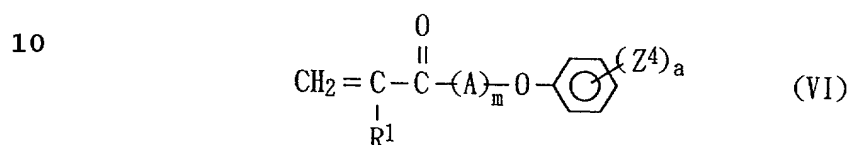
wherein  $\text{R}^1$  is a hydrogen atom or a methyl group, B is an ethylenoxy group,  $\text{Z}^1$  is a halogen atom, an alkyl group of 1 to 20 carbon atoms, a cycloalkyl group of 3 to 10 carbon atoms, an aryl group of 6 to 14 carbon atoms, an amino group, an alkylamino group of 1 to 10 carbon atoms, a dialkylamino group of 2 to 20 carbon atoms, a nitro group, a cyano group, a mercapto group, an alkylmercapto group of 1 to 10 carbon atoms, an allyl group, a hydroxyalkyl group of 1 to 20 carbon atoms, a carboxyalkyl group wherein the alkyl group has 1 to 10 carbon atoms, an acyl group having an alkyl group of 1 to 10 carbon atoms, an alkoxy group of 1 to 20 carbon atoms or a group containing an heterocyclic group, m is an integer of 4 to 20, and n is an integer of 0 to 5.

The invention further provides a photosensitive resin composition comprising

(A') a binder polymer,

(B) a photo-polymerization initiator, and

5 (C'') a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond which comprises a compound represented by the general formula (VI)



wherein R<sup>1</sup> is a hydrogen atom or a methyl group, A is an  
15 alkylenoxy group of 2 to 6 carbon atoms, Z<sup>4</sup> is an alkyl group of 1 to 20 carbon atoms, m is an integer of 4 to 20, and a is an integer of 1 to 5.

Another object of the invention is to provide a  
20 photosensitive element which is excellent in adhesiveness, low tendency to scum and workability.

Accordingly, the invention provides a photosensitive  
element produced by applying the photosensitive resin  
composition of the invention to a support, and then drying  
the photosensitive resin composition to form a photosensitive  
25 resin composition layer.

In one embodiment, the photosensitive element of the  
invention has a protective film applied to the photosensitive  
resin composition layer.

Another object of the invention is to provide a process  
30 for producing resist patterns, in which a photosensitive element having excellent adhesiveness, low tendency to scum and extremely good workability is used and which therefore  
extremely facilitates the production of printed wiring boards  
with higher density and the automatic production of printed  
35 wiring boards.

Accordingly, the invention provides a process for producing a resist pattern comprising laminating the photosensitive element of the invention on a substrate to be processed for forming a circuit, with the photosensitive resin composition layer placed in contact with the substrate, exposing the photosensitive resin composition layer by irradiating it with an active ray in a pattern of an image to radiation-cure exposed areas of the photosensitive resin composition layer, and then developing by removing unexposed areas of the photosensitive resin composition layer.

In one embodiment, a protective film is applied to the photosensitive resin composition layer, and the photosensitive element is laminated on the substrate to be processed for forming a circuit while the protective film is being peeled off from the photosensitive resin composition layer.

Another object of the invention is to provide a process for producing a printed wiring board, in which a photosensitive element having excellent adhesiveness, low tendency to scum and extremely good workability is used for the production of resist patterns and which therefore extremely facilitates the production of printed wiring boards with higher density and the automatic production of printed wiring boards.

Accordingly, the invention provides a process for producing a printed wiring board, comprising etching or plating the substrate bearing the resist pattern produced by the process for producing a resist pattern of the invention.

### **Best Mode for Carrying Out the Invention**

Hereinafter, the components contained in the photosensitive resin composition of the invention will be described in detail.

According to the invention, in the component (A) that is a carboxyl group-containing binder polymer containing styrene

or a styrene derivative as a copolymerized constituent, the styrene or the styrene derivative is an essential copolymerized constituent to ensure adhesiveness and high resolution on overdevelopment.

- 5           Examples of usable styrene derivatives include  $\alpha$ -methylstyrene, p-methylstyrene, p-ethylstyrene, p-methoxystyrene, p-ethoxystyrene, p-chlorostyrene and p-bromostyrene. The styrene and styrene derivatives may further have, on their benzene rings, a functional
- 10   substituent such as a nitro group, a nitrile group, an alkoxyl group, an acyl group, a sulfone group, a hydroxyl group or a halogen atom, but, preferably, have only one alkyl group such as a methyl group or a tert-butyl group. In view of adhesiveness preferred examples are styrene and p-
- 15   methylstyrene. These styrene and styrene derivatives are used individually or in combination of two or more.

          The component (A) to be used in the invention that is a carboxyl group-containing binder polymer containing styrene or a styrene derivative as a copolymerized constituent

20   further contains as another essential copolymerized constituent a carboxyl group-containing monomer which is copolymerizable with styrene or the styrene derivative, and may further contain other vinyl monomers as optional copolymerized constituents.

- 25           Examples of usable carboxyl group-containing monomers include acrylic acid, acrylic acid derivatives such as  $\alpha$ -bromoacrylic acid,  $\alpha$ -chloroacrylic acid,  $\beta$ -furylacrylic acid and  $\beta$ -styrylacrylic acid, methacrylic acid, methacrylic acid derivatives such as  $\alpha$ -bromomethacrylic acid,  $\alpha$ -
- 30   chloromethacrylic acid,  $\beta$ -furylmethacrylic acid and  $\beta$ -styrylmethacrylic acid, maleic acid, maleic anhydride, maleic acid monoesters such as monomethyl maleate, monoethyl maleate and monoisopropyl maleate, fumaric acid, cinnamic acid,  $\alpha$ -cyanocinnamic acid, itaconic acid, crotonic acid and



propionic acid. These carboxyl group-containing monomers are used individually or in combination of two or more.

Examples of usable vinyl monomers other than styrene, the styrene derivatives and the carboxyl group-containing monomers include acrylamides such as 2,2,3,3-tetrafluoropropylacrylateacrylamide, 2,2,3,3-tetrafluoropropylmethacrylateacrylamide and diacetoneacrylamide, acrylonitrile, ethers of vinyl alcohol such as vinyl n-butyl ether, alkyl acrylates and alkyl methacrylates.

Examples of the alkyl acrylates and alkyl methacrylates include the compounds represented by the general formula (III) and derivatives thereof in which the alkyl group has substituent group(s), for example, a hydroxyl group, an epoxy group or a halogen group.

Examples of  $R^6$  in the general formula (III) include a methyl group, an ethyl group, a propyl group, a butyl group, a pentyl group, a hexyl group, a heptyl group, an octyl group, a nonyl group, a decyl group, an undecyl group, a dodecyl group and structural isomers of these groups.

Examples of the monomers represented by the general formula (III) include methyl acrylate, ethyl acrylate, propyl acrylate, butyl acrylate, pentyl acrylate, hexyl acrylate, heptyl acrylate, octyl acrylate, 2-ethylhexyl acrylate, nonyl acrylate, decyl acrylate, undecyl acrylate, dodecyl acrylate, methyl methacrylate, ethyl methacrylate, propyl methacrylate, butyl methacrylate, pentyl methacrylate, hexyl methacrylate, heptyl methacrylate, octyl methacrylate, 2-ethylhexyl methacrylate, nonyl methacrylate, decyl methacrylate, undecyl methacrylate and dodecyl methacrylate.

The component (A) that is a carboxyl group-containing binder polymer containing styrene or a styrene derivative as a copolymerized constituent preferably contains 15 to 35 % by weight of methacrylic acid, 10 to 35 % by weight of styrene or a styrene derivative and 30 to 75 % by weight of the

monomer represented by the general formula (III) as polymerization constituents.

That is, the content of methacrylic acid is preferably 15 to 35 % by weight, more preferably 20 to 30 % by weight, particularly preferably 23 to 26 % by weight based on the whole quantity of the component (A). If it is less than 15 % by weight, the minimum development time may be prolonged to deteriorate the workability, and if more than 35 % by weight, adhesiveness may be reduced.

The content of styrene or the styrene derivative is preferably 10 to 35 % by weight, more preferably 15 to 30 % by weight, particularly preferably 20 to 25 % by weight based on the whole quantity of the component (A). If it is less than 10 % by weight, the resist may tend to swell to reduce the adhesiveness on overdevelopment, and if more than 35 % by weight, the minimum development time may be prolonged to deteriorate the workability.

The content of the monomer represented by the general formula (III) is preferably 30 to 75 % by weight, more preferably 40 to 65 % by weight, particularly preferably 49 to 57 % by weight based on the whole quantity of the component (A). If it is less than 30 % by weight, the resist may become brittle and have poor cross-cut properties, and if more than 75 % by weight, the adhesiveness may be reduced.

For example, the component (A) may be produced by copolymerizing the above described monomers through vinyl polymerization.

In view of good film quality and high resolution, the component (A) that is a carboxyl group-containing binder polymer containing styrene or a styrene derivative as a copolymerized constituent preferably has a weight average molecular weight of 30,000 to 80,000, more preferably 40,000 to 70,000, particularly preferably 50,000 to 60,000. If the weight average molecular weight is less than 30,000, the film quality may be deteriorated, and if more than 80,000, the

resolution may be lowered. Herein, the weight average molecular weight is measured through gel permeation chromatography, based on the calibration curve of a standard, polystyrene.

5 In the invention, the component (A) that is a carboxyl group-containing binder polymer containing styrene or a styrene derivative as a copolymerized constituent preferably has an acid value of 90 to 500 mgKOH/g, more preferably 90 to 300 mgKOH/g. If the acid value is less than 90 mgKOH/g, the  
10 development time may be prolonged, and if more than 500 mgKOH/g, the radiation-cured resist may have poor resistance to developers.

Examples of photo-polymerization initiators usable as the component (B) in the invention include aromatic ketones  
15 such as benzophenone, N,N'-tetramethyl-4,4'-diaminobenzophenone (Michler's ketone), N,N'-tetraethyl-4,4'-diaminobenzophenone, 4-methoxy-4'-dimethylaminobenzophenone, 2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)butanone-1, 2-ethylanthraquinone and phenanthrenequinone, benzoin ether  
20 compounds such as benzoin methyl ether, benzoin ethyl ether and benzoin phenyl ether, benzoin compounds such as methylbenzoin and ethylbenzoin, benzyl derivatives such as benzyl diethyl ketal, 2,4,5-triarylimidazole dimers, acridine derivatives such as 9-phenylacridine and 1,7-bis(9,9'-  
25 acridinyl)heptane, and N-phenylglycine.

In view of adhesiveness and sensitivity, preferred are 2,4,5-triarylimidazole dimers, for example, 2,2'-bis(o-chlorophenyl)-4,5,4',5'-tetraphenyl-1,2'-imidazole dimer, 2-(o-chlorophenyl)-4,5-diphenylimidazole dimer, 2,2'-bis(o-chlorophenyl)-4,4',5,5'-tetra(p-chlorophenyl)imidazole dimer,  
30 2-(o-chlorophenyl)-4,5-di(m-methoxyphenyl)imidazole dimer, 2,2'-bis(o-chlorophenyl)-4,4',5,5'-tetra(p-fluorophenyl)imidazole dimer, 2,2'-bis(o-bromophenyl)-4,4',5,5'-tetra(o-chloro-p-methoxyphenyl)imidazole dimer,  
35 2,2'-bis(o-chlorophenyl)-4,4',5,5'-tetra(o,p-

- dichlorophenyl)imidazole dimer, 2,2'-bis(o-chlorophenyl)-  
 4,4',5,5'-tetra(o,p-dibromophenyl)imidazole dimer, 2,2'-  
 bis(o-chlorophenyl)-4,4',5,5'-tetra(p-  
 chloronaphthyl)imidazole dimer, 2,2'-bis(m,p-dichlorophenyl)-  
 5 4,4',5,5'-tetraphenylimidazole dimer, 2,2'-bis(o,p-  
 dichlorophenyl)-4,4',5,5'-tetraphenylimidazole dimer, 2,2'-  
 bis(o,p-dichlorophenyl)-4,4',5,5'-tetra(o,p-  
 dichlorophenyl)imidazole dimer, 2-(o-fluorophenyl)-4,5-  
 diphenylimidazole dimer, 2-(o-methoxyphenyl)-4,5-  
 10 diphenylimidazole dimer, 2-(p-methoxyphenyl)-4,5-  
 diphenylimidazole dimer, 2,4-di(p-methoxyphenyl)-5-  
 phenylimidazole dimer, 2-(2,4-dimethoxyphenyl)-4,5-  
 diphenylimidazole dimer, 2-(p-methylmercaptophenyl)-4,5-  
 diphenylimidazole dimer, 2,2'-bis(p-bromophenyl)-4,4',5,5'-  
 15 tetraphenylimidazole dimer, 2,2'-bis(o-bromophenyl)-  
 4,4',5,5'-tetra(o,p-dichlorophenyl)imidazole dimer, 2,2'-  
 bis(o-bromophenyl)-4,4',5,5'-tetra(p-iodophenyl)imidazole  
 dimer, 2,2'-bis(m-bromophenyl)-4,4',5,5'-tetraphenylimidazole  
 dimer and 2,2'-bis(m,p-dibromophenyl)-4,4',5,5'-  
 20 tetraphenylimidazole dimer. These are used individually or  
 in combination of two or more.

The component (C) to be used in the invention that is a  
 photo-polymerizable compound having in its molecule at least  
 one polymerizable ethylenically unsaturated bond contains the  
 25 compound represented by the general formula (I) as an  
 essential ingredient.

Examples of A in the general formula (I) and the general  
 formula (VI) include an alkylenoxy group of 2 to 6 carbon  
 atoms, such as an ethylenoxy group, a propylenoxy group, an  
 30 isopropylenoxy group, a butylenoxy group, a pentylenoxy group  
 and a hexylenoxy group, with an ethylenoxy group preferred in  
 view of adhesiveness. m is an integer of 4 to 20, preferably  
 an integer of 6 to 18 in view of low tendency to scum and  
 resistance to developers, particularly preferably an integer  
 35 of 8 to 12.

The isopropylene group in the above-mentioned isopropylenoxy group is represented by  $-\text{CH}(\text{CH}_3)\text{CH}_2-$ . When A in the general formula (I) is an isopropylenoxy group, the group  $-(\text{A})-$  may have the structure of either (i)  $-(\text{O}-\text{CH}(\text{CH}_3)\text{CH}_2)-$  or (ii)  $-(\text{O}-\text{CH}_2\text{CH}(\text{CH}_3)-)-$ , and when A is an isopropylenoxy group, each isopropylenoxy group in the group  $-(\text{A})_m-$  may have the structure of either (i) or (ii), and the plural A's may be identical with or different from each other. When A's include two or more kinds of alkyleneoxy groups, the alkyleneoxy groups may be linked either randomly or in blocks.

The  $\text{Z}^1$  in the general formula (I) and the general formula (V) is a halogen atom, an alkyl group of 1 to 20 carbon atoms, a cycloalkyl group of 3 to 10 carbon atoms, an aryl group of 6 to 14 carbon atoms, an amino group, an alkylamino group of 1 to 10 carbon atoms, a dialkylamino group of 2 to 20 carbon atoms, a nitro group, a cyano group, a mercapto group, an alkylmercapto group of 1 to 10 carbon atoms, an allyl group, a hydroxyalkyl group of 1 to 20 carbon atoms, a carboxyalkyl group the alkyl group of which has 1 to 10 carbon atoms, an acyl group the alkyl group of which has 1 to 10 carbon atoms, an alkoxy group of 1 to 20 carbon atoms or a group containing a heterocyclic group. The hydrogen atoms of the alkyl groups in  $\text{Z}^1$  may be substituted by halogen atoms. In view of resistance to developers, developability and adhesiveness,  $\text{Z}^1$  is preferably an alkyl group of 1 to 20 carbon atoms, more preferably an alkyl group of 4 to 14 carbon atoms. n is an integer of 0 to 5, preferably an integer of 1 to 3 in view of availability and developability. When n is 2 or more, the plural  $\text{Z}^1$ 's may be identical with or different from each other.

Examples of halogen atoms for  $\text{Z}^1$  in the general formula (I) and the general formula (V) include fluorine, chlorine, bromine, iodine and astatine.

Examples of alkyl groups of 1 to 20 carbon atoms for  $Z^1$  and  $Z^4$  in the general formula (I), the general formula (V) and the general formula (VI) include a methyl group, an ethyl group, an n-propyl group, an isopropyl group, a n-butyl group, a sec-butyl group, a tert-butyl group, a pentyl group, a hexyl group, a heptyl group, an octyl group, a nonyl group, a decyl group, an undecyl group, a dodecyl group, a tridecyl group, a tetradecyl group, a pentadecyl group, an octadecyl group, a nonadecyl group and eicocyl group, with alkyl groups of 7 to 12 carbon atoms preferred, and a nonyl group particularly preferred.

Examples of cycloalkyl groups of 3 to 10 carbon atoms for  $Z^1$  in the general formula (I) and the general formula (V) include a cyclopropyl group, a cyclobutyl group, a cyclopentyl group, a cyclohexyl group, a cycloheptyl group and a cyclooctyl group.

Examples of aryl groups of 6 to 14 carbon atoms for  $Z^1$  in the general formula (I) and the general formula (V) include a phenyl group, a tolyl group, a xylyl group, a biphenyl group, a naphthyl group, an anthryl group and a phenanthryl group, which may be substituted by a halogen atom, an amino group, a nitro group, a cyano group, a mercapto group, an allyl group or an alkyl group of 1 to 20 carbon atoms.

Examples of alkylamino groups of 1 to 10 carbon atoms for  $Z^1$  in the general formula (I) and the general formula (V) include a methylamino group, an ethylamino group, a propylamino group and an isopropylamino group.

Examples of dialkylamino groups of 2 to 20 carbon atoms for  $Z^1$  in the general formula (I) and the general formula (V) include a dimethylamino group, a diethylamino group, a dipropylamino group and a diisopropylamino group.

Examples of alkylmercapto groups of 1 to 10 carbon atoms for  $Z^1$  in the general formula (I) and the general formula (V)

include a methylmercapto group, an ethylmercapto group and a propylmercapto group.

Examples of hydroxyalkyl groups of 1 to 20 carbon atoms for  $Z^1$  in the general formula (I) and the general formula (V) include a hydroxymethyl group, a hydroxyethyl group, a hydroxypropyl group, a hydroxyisopropyl group and a hydroxybutyl group.

Examples of carboxyalkyl groups for  $Z^1$  in the general formula (I) and the general formula (V) the alkyl groups of which has 1 to 10 carbon atoms include a carboxymethyl group, a carboxyethyl group, a carboxypropyl group and a carboxybutyl group.

Examples of acyl groups for  $Z^1$  in the general formula (I) and the general formula (V) the alkyl group of which has 1 to 10 carbon atoms include a formyl group, an acetyl group, a propionyl group, a butyryl group, an isobutyryl group, a valeryl group, an isovaleryl group and a pivaloyl group.

Examples of alkoxy groups of 1 to 20 carbon atoms for  $Z^1$  in the general formula (I) and the general formula (V) include a methoxy group, an ethoxy group, a propoxy group and a butoxy group.

Examples of groups containing a heterocyclic group for  $Z^1$  in the general formula (I) and the general formula (V) include a furyl group, a thienyl group, a pyrrolyl group, a thiazolyl group, an indolyl group and a quinolyl group.

Examples of the compounds represented by the general formula (I) include nonylphenoxypoly(ethylenoxy) acrylates, nonylphenoxypoly(ethylenoxy) methacrylates, nonylphenoxypoly(propylenoxy) acrylates, nonylphenoxypoly(propylenoxy) methacrylates, butylphenoxypoly(ethylenoxy) acrylates, butylphenoxypoly(ethylenoxy) methacrylates, butylphenoxypoly(propylenoxy) acrylates and butylphenoxypoly(propylenoxy) methacrylates.

Examples of the nonylphenoxypoly(ethylenoxy) acrylates include nonylphenoxytetra(ethylenoxy) acrylate, nonylphenoxypenta(ethylenoxy) acrylate, nonylphenoxyhexa(ethylenoxy) acrylate, 5 nonylphenoxyhepta(ethylenoxy) acrylate, nonylphenoxyocta(ethylenoxy) acrylate, nonylphenoxynona(ethylenoxy) acrylate, nonylphenoxydeca(ethylenoxy) acrylate and nonylphenoxyundeca(ethylenoxy) acrylate.

10 Examples of the nonylphenoxypoly(ethylenoxy) methacrylates include nonylphenoxytetra(ethylenoxy) methacrylate, nonylphenoxypenta(ethylenoxy) methacrylate, nonylphenoxyhexa(ethylenoxy) methacrylate, nonylphenoxyhepta(ethylenoxy) methacrylate, 15 nonylphenoxyocta(ethylenoxy) methacrylate, nonylphenoxynona(ethylenoxy) methacrylate, nonylphenoxydeca(ethylenoxy) methacrylate and nonylphenoxyundeca(ethylenoxy) methacrylate.

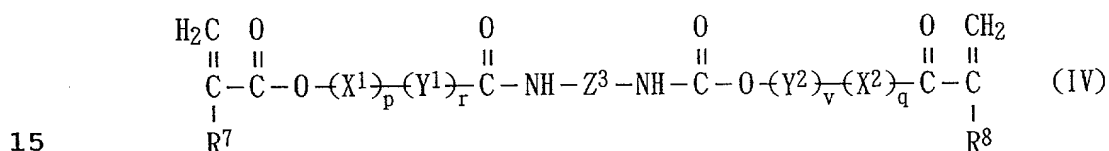
Examples of the butylphenoxypoly(ethylenoxy) acrylates 20 include butylphenoxytetra(ethylenoxy) acrylate, butylphenoxypenta(ethylenoxy) acrylate, butylphenoxyhexa(ethylenoxy) acrylate, butylphenoxyhepta(ethylenoxy) acrylate, butylphenoxyocta(ethylenoxy) acrylate, 25 butylphenoxynona(ethylenoxy) acrylate, butylphenoxydeca(ethylenoxy) acrylate and butylphenoxyundeca(ethylenoxy) acrylate.

Examples of the butylphenoxypoly(ethylenoxy) methacrylates include 30 butylphenoxytetra(ethylenoxy) methacrylate, butylphenoxypenta(ethylenoxy) methacrylate, butylphenoxyhexa(ethylenoxy) methacrylate, butylphenoxyhepta(ethylenoxy) methacrylate, butylphenoxyocta(ethylenoxy) methacrylate, 35 butylphenoxynona(ethylenoxy) methacrylate,



butylphenoxydeca(ethylenoxy) methacrylate and butylphenoxyundeca(ethylenoxy) methacrylate.

In view of flexibility, it is preferable that the component (C) [and the component (C') and the component (C'')] to be used in the invention that is a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond further contains, in addition to the compound represented by the general formula (I), a compound represented by the general formula (II), particularly preferably a compound represented by the general formula (IV)



wherein  $\text{R}^7$  and  $\text{R}^8$  have the same definition as that of  $\text{R}^2$  in the general formula (II),  $\text{Z}^3$  has the same definition as that of  $\text{Z}^2$  in the general formula (II),  $\text{X}^1$  and  $\text{X}^2$  are an ethylenoxy group,  $\text{Y}^1$  and  $\text{Y}^2$  each independently are a propylenoxy group, an isopropylenoxy group, a butylenoxy group, a pentylenoxy group or a hexylenoxy group,  $p$ ,  $q$ ,  $r$  and  $v$  each independently are an integer of 1 to 14.

In the general formulae (II) and (IV),  $\text{R}^2$ ,  $\text{R}^3$ ,  $\text{R}^7$  and  $\text{R}^8$  each independently are a hydrogen atom or an alkyl group of 1 to 6 carbon atoms, such as a methyl group, an ethyl group, a n-propyl or an isopropyl group. When  $r$  and  $v$  that are the numbers of the repeating units  $\text{Y}^1$  and  $\text{Y}^2$  are 2 or more, the two or more  $\text{Y}^1$ 's and the two or more  $\text{Y}^2$ 's, respectively, may be identical with or different from each other, and the arrangements of  $\text{Y}^1$ 's of two or more kinds and  $\text{Y}^2$ 's of two or more kinds may be either random or block. Also the arrangement of  $\text{X}^1$ ,  $\text{X}^2$ ,  $\text{Y}^1$  and  $\text{Y}^2$  may be either random or block.

Examples of divalent hydrocarbon groups of 1 to 16 carbon atoms for  $Z^2$  and  $Z^3$  in the general formulae (II) and (IV) include an alkylene group, such as an ethylene group, a hexylene group, a 2-ethylhexylene group, a trimethylhexylene group or a decylene group, a cycloalkylene group, such as a cyclohexylene group or a bicyclohexylene group, and an arylene group, such as a phenylene group, a biphenylene group or a naphthylene group.

Examples of the compounds represented by the general formulae (II) and (IV) include UA-11 and UA-13 (Trade names) produced by Shin-Nakamura Kagaku Kogyo Co., Ltd.

Examples of other photo-polymerizable compounds having in their molecules at least one polymerizable ethylenically unsaturated bond than the compounds represented by the general formulae (I), (II) and (IV) include polyhydric alcohols, compounds obtainable by the reaction of an polyhydric alcohol with an  $\alpha, \beta$ -unsaturated carboxylic acid, 2,2-bis[4-(acryloxypolyethoxy)phenyl]propanes, 2,2-bis[4-(methacryloxypolyethoxy)phenyl]propanes, compounds obtainable by the reaction of a glycidyl group-containing compound with an  $\alpha, \beta$ -unsaturated carboxylic acid, urethane monomers,  $\gamma$ -chloro- $\beta$ -hydroxypropyl- $\beta'$ -acryloyloxyethyl-o-phthalate,  $\gamma$ -chloro- $\beta$ -hydroxypropyl- $\beta'$ -methacryloyloxyethyl-o-phthalate,  $\beta$ -hydroxyethyl- $\beta'$ -acryloyloxyethyl-o-phthalate,  $\beta$ -hydroxyethyl- $\beta'$ -methacryloyloxyethyl-o-phthalate,  $\beta$ -hydroxypropyl- $\beta'$ -acryloyloxyethyl-o-phthalate,  $\beta$ -hydroxypropyl- $\beta'$ -methacryloyloxyethyl-o-phthalate, alkyl acrylates and alkyl methacrylates.

Examples of the compounds obtainable by the reaction of a polyhydric alcohol with an  $\alpha, \beta$ -unsaturated carboxylic acid include polyethylene glycol diacrylates with 2 to 14 ethylene groups, polyethylene glycol dimethacrylates with 2 to 14 ethylene groups, polypropylene glycol diacrylates with 2 to

14 propylene groups, polypropylene glycol dimethacrylates with 2 to 14 propylene groups, trimethylolpropane diacrylate, trimethylolpropane dimethacrylate, trimethylolpropane triacrylate, trimethylolpropane trimethacrylate, 5 trimethylolpropane ethoxytriacylate, trimethylolpropane ethoxytrimethacrylate, tetramethylolmethane triacrylate, tetramethylolmethane trimethacrylate, tetramethylolmethane tetracrylate, tetramethylolmethane tetramethacrylate, polypropylene glycol diacrylates with 2 to 14 propylene 10 groups, polypropylene glycol dimethacrylates with 2 to 14 propylene groups, dipentaerithritol pentacrylate, dipentaerithritol pentamethacrylate, dipentaerithritol hexacrylate and dipentaerithritol hexamethacrylate.

Examples of the  $\alpha, \beta$ -unsaturated carboxylic acids 15 include acrylic acid and methacrylic acid.

Examples of the 2,2-bis[4-(acryloxypolyethoxy)phenyl]propanes include 2,2-bis[4-(acryloxydiethoxy)phenyl]propane, 2,2-bis[4-(acryloxytriethoxy)phenyl]propane, 2,2-bis[4-(acryloxy-pentaethoxy)phenyl]propane and 2,2-bis[4-(acryloxydecaethoxy)phenyl]propane. 20

Examples of the 2,2-bis[4-(methacryloxypolyethoxy)phenyl]propanes include 2,2-bis[4-(methacryloxydiethoxy)phenyl]propane, 2,2-bis[4-(methacryloxytriethoxy)phenyl]propane, 2,2-bis[4-(methacryloxy-pentaethoxy)phenyl]propane and 2,2-bis[4-(methacryloxydecaethoxy)phenyl]propane. 2,2-bis[4-(methacryloxy-pentaethoxy)phenyl]propane is commercially available by the trade name of BPE-500 (produced by Shin- 25 Nakamura Kagaku Kogyo Co., Ltd.). 30

Examples of the glycidyl group-containing compounds include trimethylolpropane triglycidyl ether triacrylate, trimethylolpropane triglycidyl ether trimethacrylate, 2,2-bis(4-acryloxy-2-hydroxy-propyloxyphenyl)propane and 2,2-bis(4-methacryloxy-2-hydroxy-propyloxyphenyl)propane. 35

Examples of the urethane monomers include addition reaction products of an acrylic or methacrylic monomer having an OH group at the  $\beta$ -position with isophorone diisocyanate, 2,6-toluene diisocyanate, 2,4-toluene diisocyanate or 1,6-hexamethylene diisocyanate; and tris(methacryloxytetraethyleneglycolisocyanatehexamethylene) isocyanurate.

Examples of the alkyl acrylates include methyl acrylate, ethyl acrylate, butyl acrylate and 2-ethylhexyl acrylate.

Examples of the alkyl methacrylates include methyl methacrylate, ethyl methacrylate, butyl methacrylate and 2-ethylhexyl methacrylate.

These compounds are used individually or in combination of two or more.

The component (A') that is used in the present invention as a binder polymer is not particularly limited. For example, as the component (A'), the above-described component (A) may be used, and polymers which do not contain styrene or a styrene derivative as a copolymerization constituent may also be used. The preferred ranges of the weight average molecular weight and acid value of the component (A') are the same as those described for the component (A).

The quantity of the component (A) to be used in the invention that is the carboxyl group-containing binder polymer containing styrene or a styrene derivative as a copolymerized constituent is preferably 40 to 70 parts by weight, more preferably 45 to 60 parts by weight, particularly preferably 50 to 55 parts by weight based on 100 parts by weight of the sum total of the component (A) and the component (C). If it is less than 40 parts by weight, the radiation-cured product may become brittle, and the photosensitive element produced therefrom may have poor film quality, and if it is more than 70 parts by weight, the adhesiveness and resolution may be lowered.

The quantity of the component (B) that is the photo-polymerization initiator to be used in the invention is preferably 0.1 to 10 parts by weight, more preferably 1 to 8 parts by weight, particularly preferably 2 to 5 parts by weight based on 100 parts by weight of the sum total of the component (A) and the component (C). If it is less than 0.1 parts by weight, the sensitivity may become insufficient, and if it is more than 10 parts by weight, the absorption of lights near the surface of the composition may increase at the time of exposure, causing insufficient radiation-cure of the inside.

The quantity of the component (C) that is the photo-polymerizable compound to be used in the invention is preferably 30 to 60 parts by weight, particularly preferably 45 to 50 parts by weight based on 100 parts by weight of the sum total of the component (A) and the component (C).

The content of the compound represented by the general formula (I) in the component (C) is preferably 3 to 20 parts by weight, more preferably 5 to 20 parts by weight based on 100 parts by weight of the sum total of the component (A) and the component (C). If it is less than 3 parts by weight, scumming may increase, the sensitivity may become insufficient to form strong and flexible cured film, and if it is more than 20 parts by weight, the sensitivity may become insufficient.

The content of the compound represented by the general formula (II) in the component (C) is preferably 5 to 40 parts by weight, more preferably 7 to 30 parts by weight, particularly preferably 10 to 25 parts by weight based on 100 parts by weight of the sum total of the component (A) and the component (C). If it is less than 5 parts by weight, the sensitivity may become insufficient to form strong and flexible cured film, and if it is more than 40 parts by weight, the sensitivity may become insufficient.

The quantity of the component (A') that is the binder polymer to be used in the invention is preferably 40 to 70 parts by weight, more preferably 45 to 60 parts by weight, particularly preferably 50 to 55 parts by weight based on 100 parts by weight of the sum total of the component (A') and the component (C') or the component (C'').

The quantity of the component (B) that is the photopolymerization initiator to be used in the invention is preferably 0.1 to 10 parts by weight, more preferably 1 to 8 parts by weight, particularly preferably 2 to 5 parts by weight based on 100 parts by weight of the sum total of the component (A') and the component (C') or the component (C'').

The quantity of the component (C') or the component (C'') that is the photopolymerizable compound to be used in the invention is preferably 30 to 60 parts by weight, particularly preferably 45 to 50 parts by weight based on 100 parts by weight of the sum total of the component (A') and the component (C') or the component (C'').

The content of the compound represented by the general formula (V) in the component (C') is preferably 3 to 20 parts by weight, more preferably 5 to 20 parts by weight based on 100 parts by weight of the sum total of the component (A') and the component (C'). Also, the content of the compound represented by the general formula (VI) in the component (C'') is preferably 3 to 20 parts by weight, more preferably 5 to 20 parts by weight based on 100 parts by weight of the sum total of the component (A') and the component (C'').

The content of the compound represented by the general formula (II) in the component (C') or the component (C'') is preferably 5 to 40 parts by weight, more preferably 7 to 30 parts by weight, particularly preferably 10 to 25 parts by weight based on 100 parts by weight of the sum total of the component (A') and the component (C') or the component (C'').

The photosensitive resin composition of the invention may optionally contain dyes such as Malachite Green, photo-

couplers such as leuco crystal violet, anti-heat-coloring agents, plasticizers such as p-toluenesulfonamide, pigments, fillers, anti-foaming agents, flame retardants, stabilizers, adhesiveness improvers, leveling agents, peeling promoters, antioxidants, perfumes, imaging agents and heat-crosslinking agents, in their respective quantities of 0.01 to 20 parts by weight based on 100 parts by weight of the sum total of the component (A) and the component (C). These may be used individually or in combination of two or more.

The photosensitive resin composition may be applied as it is or, if necessary, in a state of a solution of a solid content of 30 to 60 % by weight by dissolving it in a solvent of a mixture of solvents, such as methanol, ethanol, acetone, methyl ethyl ketone, methyl cellosolve, ethyl cellosolve, toluene or N,N-dimethylformamide.

It is not limitative but preferable to use the photosensitive resin composition of the invention by applying it as a liquid resist to metallic surface, for example the surface of copper, copper alloys, nickel, chromium, iron, iron alloys such as stainless steel, preferably copper or copper alloys, and drying to form a photosensitive resin composition layer, and then optionally coating it with a protective film, or in a form of a photosensitive element.

The thickness of the photosensitive resin composition layer depends on its use, and after drying, the thickness is preferably 1 to 200  $\mu\text{m}$ , more preferably 1 to 100  $\mu\text{m}$ , particularly preferably 1 to 30  $\mu\text{m}$ . If the thickness is less than 1  $\mu\text{m}$ , application may be difficult in industrial processes, and photosensitive resin composition layers thicker than 100  $\mu\text{m}$  cannot take much effect of the invention and may have low sensitivity. If the thickness is more than 200  $\mu\text{m}$ , the bottom portion of resist may become difficult to radiation-cure. The protective film that is optionally applied to the photosensitive resin composition layer is

inert polyolefin film, such as polyethylene or polypropylene, with polyethylene film preferred in view of peelability from the photosensitive resin composition layer.

The photosensitive element is obtainable by applying the  
5 photosensitive resin composition to a support, such as a polymer film made of polyethyleneterephthalate, polypropylene, polyethylene or a polyester, and then drying the photosensitive resin composition to form a photosensitive resin composition layer. The application may be carried out  
10 by any known method, such as application using a roll coater, a comma coater, a gravure coater, an air knife coater, a die coater or a bar coater. The drying may be carried out at 80 to 150 °C for about 5 to 30 minutes.

The polymer film should be removable from the  
15 photosensitive resin composition layer later, and, therefore, should not be subjected to a surface treatment which makes it unremovable nor made of an unremovable material. The thickness of the polymer film is preferably 1 to 100  $\mu\text{m}$ , more preferably 1 to 30  $\mu\text{m}$ . Polymer films thinner than 1  
20  $\mu\text{m}$  may have so poor mechanical strength as to cause troubles such as breakage of the polymer film on application, and those thicker than 30  $\mu\text{m}$  may increase the cost due to reduction of resolution.

It is possible to use one polymer film as the support  
25 film for supporting the photosensitive resin composition layer, and to laminate another polymer film as the protective film on the photosensitive resin composition layer.

The obtained photosensitive element of the invention comprising the two layers consisting of the photosensitive  
30 resin composition layer and the polymer film (support) may be stored as it is or by laminating a protective film on the other face of the photosensitive resin composition layer and winding it into a roll.



The production of resist patterns by using the photosensitive element may be performed, for example, by removing the protective film, if any, and then laminating the photosensitive element on a substrate to be processed for forming circuits, with the photosensitive resin composition layer heated and pressed against the substrate. In view of adhesiveness and conformability, the lamination is preferably carried out under reduced pressure. The surface to be subjected to the lamination is not limited but is generally a metal surface. The preferred but not limitative temperature to which the photosensitive resin composition layer is heated is 70 to 130°C, and the preferred but not limitative pressure of the pressing is 0.1 to 1.0 MPa (1 to 10 kg/cm<sup>2</sup>). When the photosensitive resin composition layer is heated to 70 to 130°C as described above, the substrate to be processed for forming circuits does not require preheating, but may be preheated to further improve the lamination workability.

After lamination, the photosensitive resin composition layer is irradiated with an active ray, for example, an active ray of 1 to 500 mJ/cm<sup>2</sup>, in a pattern of an image through a negative or positive mask pattern, so-called art work. When the photosensitive resin composition layer bears a transparent polymer film, it may be irradiated with the active ray through the polymer film, and when the polymer film is not transparent, it should be removed. To protect the photosensitive resin composition layer, it is preferable to use a transparent polymer film and to irradiate with an active ray through the transparent without removing it.

The source of the active ray may be any known light source capable of effectively emitting ultraviolet, such as a carbon-arc lamp, a mercury-vapor-arc lamp, an ultra-pressure mercury-arc lamp, a high-pressure mercury-arc lamp or a xenon-arc lamp. Other light sources capable of effectively emitting visible light, such as a photographic flood electric lamp or a solar lamp are also usable. Since the photo-

polymerization initiator contained in the photosensitive resin composition layer, in general, has maximum sensibility in the region of ultraviolet, it is preferable, in such a case, to use a light source of active rays which effectively emits ultraviolet.

After exposure, the support, if any, on the photosensitive resin composition layer is removed, and then development is carried out by removing the unexposed areas with a developer, such as an aqueous alkaline solution, through a known method, such as spraying, oscillatory dipping, brushing or scrubbing, to produce a resist pattern.

Examples of developers used in the invention are alkaline, aqueous solutions, which are safe and stable and easy to handle. Examples of the bases in the alkaline, aqueous solution include alkali hydroxides, such as hydroxides of lithium, sodium or potassium, alkali carbonates, such as carbonates or bicarbonates of lithium, sodium, potassium or ammonium, phosphates of alkali metals, such as potassium phosphate and sodium phosphate, pyrophosphates of alkali metals, such as sodium pyrophosphate and potassium pyrophosphate.

Preferred examples of the alkaline, aqueous solutions to be used for development include a 0.1 to 5 % by weight-dilute solution of sodium carbonate, a 0.1 to 5 % by weight-dilute solution of potassium carbonate, a 0.1 to 5 % by weight-dilute solution of sodium hydroxide and a 0.1 to 5 % by weight-dilute solution of sodium tetraborate.

The alkaline, aqueous solution for development is adjusted preferably to pH 9-11 and is adjusted to a temperature adapted to the developability of the photosensitive resin composition layer.

The aqueous alkaline solution may contain additives, such as surfactants, anti-foaming agents or small quantities of organic solvents for promoting development.

The development may be carried out, for example, by dipping or spraying, and high-pressure spraying is most suited for improving resolution.

After development, the obtained resist pattern may  
5 optionally be further cured by heating to about 60 to 250°C or by exposure with light of 0.2 to 10 mJ/cm<sup>2</sup>.

The etching after the development may be carried out with a cupric chloride solution, a ferric chloride solution, an alkali etching solution or a hydrogen peroxide etching  
10 solution, and a cupric chloride solution, having good etch factor, is preferable.

In the production of a printed wiring boards by using the photosensitive element of the invention, the surface of the substrate to be processed for forming circuits is treated  
15 by a known method, such as etching or plating, by using the developed resist pattern as a mask.

Examples of plating methods include copper-plating, such as cupric sulfate-plating or cupric pyrophosphate-plating, solder plating such as high-throw solder plating, nickel  
20 plating such as Watts bath (nickel sulfate-nickel chloride) plating or nickel sulfamate-plating, and gold plating such as hard gold-plating or soft gold-plating.

Subsequently, the resist pattern is peeled off with a more strongly alkaline, aqueous solution than the alkaline,  
25 aqueous solution used for development. Examples of the strongly alkaline, aqueous solution include a 1 to 5 % by weight-aqueous solution of sodium hydroxide and a 1 to 5 % by weight-aqueous solution of potassium hydroxide.

According to the invention, the process for producing  
30 printed wiring boards may also be used to produce multilayer printed wiring boards.

EXAMPLES 1 AND 2 AND COMPARATIVE EXAMPLES 1 TO 6

The components (A) with the ratios of the constituents as given in Table 1 were synthesized by vinyl copolymerization.

5

TABLE 1

		(A) Carboxyl group-containing binder polymer	
		a	b
Composition (% by weight)	Methacrylic acid	20	20
	Styrene	20	-
	Methyl methacrylate	60	80
Property	Weight average molecular weight	60,000	60,000
	Acid value (mgKOH/g)	130	130

The materials as given in Table 2 including components (B) and other components and solvents were mixed, the components (A) and the components (C) as given in Table 3 were added to and dissolved in the mixture, to give solutions of photosensitive resin compositions.

10

TABLE 2

Materials		Quantity
Component (B)	2-(o-chlorophenyl)-4,5-diphenylimidazole dimer	3.0 g
	N,N'-tetraethyl-4,4'-diaminobenzophenone	0.2 g
Other components	Leuco crystal violet	0.5 g
	Malachite green	0.05g
Solvents	Acetone	10.0 g
	Toluene	10.0 g
	Methanol	3.0 g
	N,N-dimethylformamide	3.0 g

15

TABLE 3

(unit: g)

Materials		Example No.		Comparative Example No.					
		1	2	1	2	3	4	5	6
(A)	a	60	60	60	60	60	-	-	-
	b	-	-	-	-	-	60	60	60
(C)	Nonylphenoxylocta(ethylenoxy) acrylate	10	10	-	-	-	10	-	10
	Nonylphenoxyethylenoxy acrylate	-	-	10	-	-	-	-	-
	EO, PO-modified urethane dimethacrylate *1	10	-	10	10	10	10	10	-
	$\beta$ -hydroxypropyl- $\beta'$ -methacryloyloxyethyl o-phthalate	-	-	-	10	-	-	-	-
	2,2-bis[4-(methacryloxy-pentaethoxy)phenyl]-propane	20	30	20	20	30	20	30	30

\*1: A compound of the general formula (IV) wherein  $R^7$  and  $R^8$  each are a methyl group,  $X^1$  and  $X^2$  each are an ethylenoxy group,  $Y^1$  and  $Y^2$  each are an isopropyleneoxy group,  $Z^3$  is a hexylene group, p and q each are 1, and r and v each are 9.

Each of the solutions of the photosensitive resin compositions prepared as above was applied evenly to a polyethyleneterephthalate film of 16  $\mu\text{m}$  in thickness (produced by Teijin Ltd., type: GS) and dried in a hot air convection dryer of 100°C for 10 minutes, to give photosensitive elements. The dried photosensitive resin composition layers were 20  $\mu\text{m}$  in thickness.

The copper-surfaces of copper-clad laminates (produced by Hitachi Chemical Company, Ltd., trade name: MCL-E-61), which are glass-epoxy materials having both sides clad with copper foil (35  $\mu\text{m}$  thick), were ground with a grinder

equipped with a brush of #600 (produced by Sankei Co., Ltd.), washed with water, and dried in an air current. The copper-clad laminates were heated to 80°C, and the photosensitive resin composition layers of the above-described

5 photosensitive elements, respectively, were laminated on the copper surfaces of the heated copper-clad laminates at 120°C under a pressure of 0.4 MPa (4 kgf/cm<sup>2</sup>).

Subsequently, by using an exposure device HMW-590 (produced by Oak Co., Ltd.) with a high-pressure mercury-arc  
10 lamp, a photo-tool with a Stofer-21-steps step tablet as a negative mask and a photo-tool with wiring patterns of the line width/space width ratios of 10/10 to 50/50 (unit: μm) as a negative mask for evaluation of adhesiveness, exposures were carried out with energy adjusted so that resists of 7  
15 steps (step Nos. 1-7) remain after development. Then the polyethyleneterephthalate films were removed, and developments were carried out by spraying a 1 % by weight-aqueous sodium carbonate solution at 30°C. The evaluation of adhesiveness was based on the width of the thinnest line that  
20 remained adhering after development. As to the evaluation of adhesiveness, the smaller the width is, the better the adhesiveness is.

To examine scumming, photosensitive resin composition layers were peeled off by a size of 0.2 cm<sup>2</sup> from the  
25 photosensitive elements produced as above, put in a 1.0 % by weight-aqueous sodium carbonate solution respectively, and then stirred with a stirrer for 2 hours at ambient temperature. To the resulting emulsions were added a polypropylene anti-foaming agent to a concentration of 0.1 %  
30 by weight, stirred further for 30 minutes. After allowed to stand twice around the clock, the emulsions were observed for scum. The results are given in Table 4.

TABLE 4

	Adhesiveness	Scumming
Example 1	20	No
Example 2	25	No
Comp. Example 1	20	Scummed
Comp. Example 2	20	Scummed
Comp. Example 3	20	Scummed
Comp. Example 4	30	No
Comp. Example 5	30	Scummed
Comp. Example 6	35	No

### Industrial Applicability

5 The photosensitive resin composition of the invention is excellent in adhesiveness and low tendency to scum and, therefore, is extremely useful as a liquid resist or a photosensitive element.

10 The photosensitive element of the present invention is excellent in adhesiveness, low tendency to scum and workability, and therefore, facilitates the production of printed wiring boards with higher density and the automatic production of printed wiring boards.

15 The process of the invention for producing resist patterns facilitates the production of printed wiring boards with higher density and the automatic production of printed wiring boards because it uses a photosensitive element having excellent adhesiveness, low tendency to scum and extremely good workability.

20 The process of the invention for producing a printed wiring board also facilitates the production of printed wiring boards with higher density and the automatic production of printed wiring boards because it uses a photosensitive element having excellent adhesiveness, low tendency to scum and extremely good workability for the  
25 production of resist patterns.

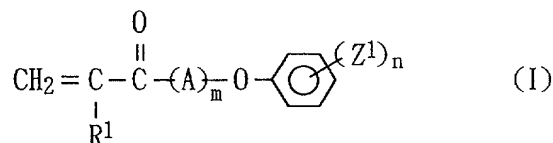
## CLAIMS

1. A photosensitive resin composition comprising

(A) a carboxyl group-containing binder polymer which  
5 contains styrene or a styrene derivative as a copolymerized  
constituent,

(B) a photo-polymerization initiator, and

(C) a photo-polymerizable compound having in its  
molecule at least one polymerizable ethylenically unsaturated  
10 bond which comprises a compound represented by the general  
formula (I)

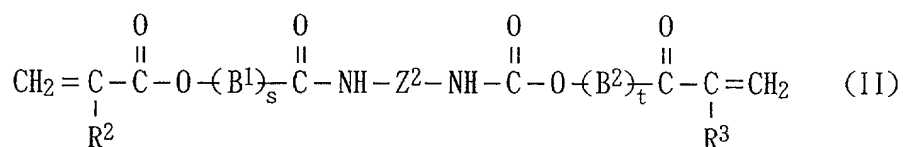


wherein  $\text{R}^1$  is a hydrogen atom or a methyl group, A is an  
alkylenoxy group of 2 to 6 carbon atoms,  $\text{Z}^1$  is a halogen  
atom, an alkyl group of 1 to 20 carbon atoms, a cycloalkyl  
20 group of 3 to 10 carbon atoms, an aryl group of 6 to 14  
carbon atoms, an amino group, an alkylamino group of 1 to 10  
carbon atoms, a dialkylamino group of 2 to 20 carbon atoms, a  
nitro group, a cyano group, a mercapto group, an  
alkylmercapto group of 1 to 10 carbon atoms, an allyl group,  
25 a hydroxyalkyl group of 1 to 20 carbon atoms, a carboxyalkyl  
group wherein the alkyl group has 1 to 10 carbon atoms, an  
acyl group having an alkyl group of 1 to 10 carbon atoms, an  
alkoxy group of 1 to 20 carbon atoms or a group containing an  
heterocyclic group, m is an integer of 4 to 20, and n is an  
30 integer of 0 to 5.

2. The photosensitive resin composition of claim 1, wherein  
the photo-polymerization initiator as the component (B) is a  
2,4,5-triarylimidazole dimer.



3. The photosensitive resin composition of claim 1, wherein the component (C) is a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond, which comprises a compound represented by the general formula (I) and a compound represented by the general formula (II)



wherein  $\text{R}^2$  and  $\text{R}^3$  each independently are a hydrogen atom or an alkyl group of 1 to 6 carbon atoms,  $\text{B}^1$  and  $\text{B}^2$  each independently are as defined above for A in the general formula (I),  $\text{Z}^2$  is a divalent hydrocarbon group of 1 to 16 carbon atoms, and s and t each independently are an integer of 1 to 28.

4. The photosensitive resin composition of claim 1, wherein the component (A) is a carboxyl group-containing binder polymer which contains styrene or a styrene derivative as a copolymerized constituent and comprises copolymerized constituents consisting of 15 to 35 % by weight of methacrylic acid, 10 to 35 % by weight of styrene or a styrene derivative and 30 to 75 % by weight of a monomer represented by the general formula (III)



wherein  $\text{R}^5$  is a hydrogen atom or a methyl group, and  $\text{R}^6$  is an alkyl group of 1 to 12 carbon atoms.

5. The photosensitive resin composition of claim 1, wherein the component (A) is a carboxyl group-containing binder

polymer which contains styrene or a styrene derivative as copolymerized constituent and has a weight average molecular weight of 30,000 to 80,000.

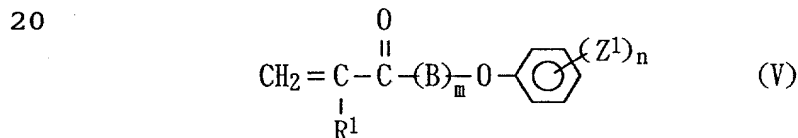
5 6. The photosensitive resin composition of claim 1, which comprises 40 to 70 parts by weight of the component (A), 0.1 to 10 parts by weight of the component (B) and 30 to 60 parts by weight of the component (C) relative to 100 parts by weight of a sum total of the component (A) and the component  
10 (C).

7. A photosensitive resin composition comprising

(A') a binder polymer,

(B) a photo-polymerization initiator, and

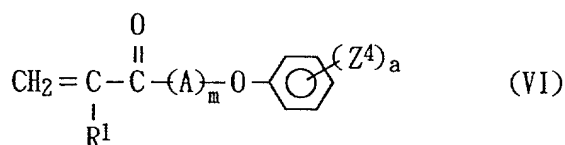
15 (C') a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond which comprises a compound represented by the general formula (V)



wherein  $\text{R}^1$  is a hydrogen atom or a methyl group, B is an  
25 ethylenoxy group,  $\text{Z}^1$  is a halogen atom, an alkyl group of 1 to 20 carbon atoms, a cycloalkyl group of 3 to 10 carbon atoms, an aryl group of 6 to 14 carbon atoms, an amino group, an alkylamino group of 1 to 10 carbon atoms, a dialkylamino group of 2 to 20 carbon atoms, a nitro group, a cyano group,  
30 a mercapto group, an alkylmercapto group of 1 to 10 carbon atoms, an allyl group, a hydroxyalkyl group of 1 to 20 carbon atoms, a carboxyalkyl group wherein the alkyl group has 1 to 10 carbon atoms, an acyl group having an alkyl group of 1 to 10 carbon atoms, an alkoxy group of 1 to 20 carbon atoms or a

group containing an heterocyclic group, m is an integer of 4 to 20, and n is an integer of 0 to 5.

8. A photosensitive resin composition comprising
- 5 (A') a binder polymer,
- (B) a photo-polymerization initiator, and
- (C'') a photo-polymerizable compound having in its molecule at least one polymerizable ethylenically unsaturated bond which comprises a compound represented by the general
- 10 formula (VI)



15 wherein R<sup>1</sup> is a hydrogen atom or a methyl group, A is an alkyleneoxy group of 2 to 6 carbon atoms, Z<sup>4</sup> is an alkyl group of 1 to 20 carbon atoms, m is an integer of 4 to 20, and a is an integer of 1 to 5.

- 20 9. A photosensitive element produced by applying the photosensitive resin composition of claim 1, 7 or 8 to a support and then drying the photosensitive resin composition to form a photosensitive resin composition layer.

- 25 10. The photosensitive element of claim 9, wherein a protective film is applied to the photosensitive resin composition layer.

- 30 11. A process for producing a resist pattern comprising laminating the photosensitive element of claim 9 on a substrate to be processed for forming a circuit with the photosensitive resin composition layer placed in contact with the substrate, exposing the photosensitive resin composition
- 35 layer by irradiating it with an active ray in a pattern of an

image to radiation-cure exposed areas of the photosensitive resin composition layer, and then developing by removing unexposed areas of the photosensitive resin composition layer.

5

12. The process of claim 11, wherein a protective film is applied to the photosensitive resin composition layer, and wherein the photosensitive element is laminated on the substrate while the protective film is being peeled off from the photosensitive resin composition layer.

10

13. A process for producing a printed wiring board, comprising etching or plating the substrate bearing the resist pattern produced by the process of claim 11.

15

## Declaration and Power of Attorney for U.S. Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled.

PHOTOSENSITIVE RESIN COMPOSITION,  
PHOTOSENSITIVE ELEMENT USING THE SAME,  
PROCESS FOR PRODUCING RESIST PATTERN  
AND PROCESS FOR PRODUCING PRINTED  
WIRING BOARD

上記発明の明細書（下記の欄で×印がついていない場合は、本書に添付）は、

the specification of which is attached hereto unless the following box is checked:

☐ \_\_\_\_月 \_\_\_\_日に提出され、米国出願または特許協定  
条約国際出願番号を \_\_\_\_\_ とし、  
（該当する場合） \_\_\_\_\_ に訂正されました。

☐ was filed on March 2, 2000  
as United States Application Number or  
PCT international Application Number  
PCT/JP00/01221 and was amended on  
February 2, 2001 (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されたとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

### Japanese Language Declaration (日本語宣言書)

私は、米国法典第35編119条(a)-(d)項又は365条(b)項に基づき下記の、米国以外の少なくとも一カ国を指定している特許協力条約365(a)項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

Prior Foreign Application(s)  
外国での先行出願

11-55457

JAPAN

(Number)  
(番号)

(Country)  
(国名)

11-287298

JAPAN

(Number)  
(番号)

(Country)  
(国名)

私は、第35編米国法典119条(e)項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

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(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

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(出願番号)

(Filing Date)  
(出願日)

私は、私自身の知識に基づいて本宣言書中で私が行う表明が真実であり、かつ私の入手した情報と私の信じるところに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行えば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby claim foreign priority under Title 35, United States Code, Section 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed.

Priority Not Claimed  
優先権主張なし

03/03/1999

(Day/Month/Year Filed)

(出願年月日)

07/10/1999

(Day/Month/Year Filed)

(出願年月日)

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.)  
(出願番号)

(Filing Date)  
(出願日)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of Title 35, United States Code Section 112. I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of application.

(Status: Patented, Pending, Abandoned)  
(現況: 特許許可済、係属中、放棄済)

(Status: Patented, Pending, Abandoned)  
(現況: 特許許可済、係属中、放棄済)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

# Japanese Language Declaration (日本語宣言書)

委任状： 私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁護士または代理人として、下記の者を指名いたします。(弁護士、または代理人の氏名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number) See list of attorneys and/or agents on page 5.

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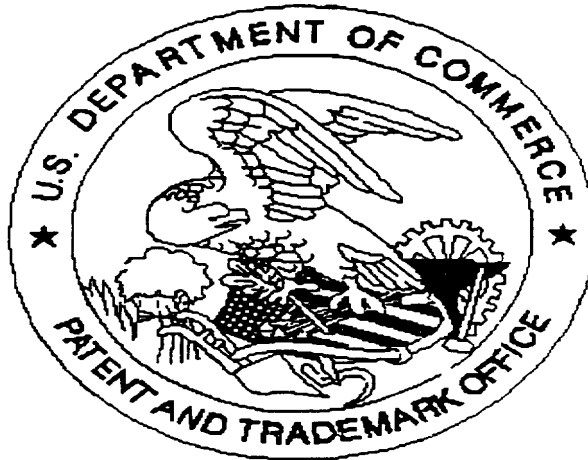
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